

CLAIMS

1. A multicarrier radio communication system configured by a plurality of communication devices having a plurality of transmitting/receiving antennas, wherein
 - 5 the communication device at a transmitting side comprises:
 - a by-channel known signal generating unit that generates known signals by channels which are spread by a code orthogonal between channels;
 - a common known signal generating unit that generates a known signal common to a plurality of channels (a common known signal); and
 - 10 a transmission signal generating unit that generates transmission signals by channels, by allocating user data, the common known signal, and the known signals by channels according to a prescribed frame format, and
 - 15 the communication device at a receiving side comprises:
 - an initial synchronizing unit that establishes a timing synchronization and a frequency synchronization using the common known signal; and
 - a by-channel known signal extracting unit that extracts the known signals by channels from a reception signal, after establishing the timing synchronization.
2. The multicarrier radio communication system according to claim 1, wherein
 - 25 the communication device at the receiving side further

comprises:

a despreading unit that despreads a reception signal with the orthogonal code based on information concerning the timing synchronization;

- 5 a matched filtering unit that calculates channel impulse responses by channels from the despreaded signal; and
- a preceding wave searching unit that determines a preceding wave position based on the channel impulse response, and
- the by-channel known signal extracting unit extracts known
- 10 signals by channels based on the preceding wave position.

3. A multicarrier radio communication system configured by a plurality of communication devices having a plurality of transmitting/receiving antennas, wherein

- 15 the communication device at a transmitting side comprises:
- a by-channel known signal generating unit that generates known signals by channels which are spread by a code orthogonal between channels;
- a same-period known signal generating unit that generates a
- 20 repetition signal of the same period between a plurality of channels (a same-period known signal); and
- a transmission signal generating unit that generates transmission signals by channels, by allocating user data, the same-period known signal, and the known signals by channels
- 25 according to a prescribed frame format, and

- the communication device at a receiving side comprises:
- an initial synchronizing unit that establishes a timing synchronization and a frequency synchronization using the same-period known signal; and
- 5 a by-channel known signal extracting unit that extracts the known signals by channels from a reception signal, after establishing the timing synchronization.
4. The multicarrier radio communication system according to claim
10 3, wherein
- the communication device at the receiving side further comprises:
- a despreading unit that despreads a reception signal with the orthogonal code based on information concerning the timing
15 synchronization;
- a matched filtering unit that calculates channel impulse responses by channels from the despreaded signal; and
- a preceding wave searching unit that determines a preceding wave position based on the channel impulse response, and
- 20 the by-channel known signal extracting unit extracts known signals by channels based on the preceding wave position.
5. A multicarrier radio communication system configured by a plurality of communication devices having a plurality of
25 transmitting/receiving antennas, wherein

- the communication device at a transmitting side comprises:
- a by-channel known signal generating unit that generates known signals by channels which are spread by a code orthogonal between channels;
- 5 a same-period known signal generating unit that copies the known signals by channels, and generates a repetition signal of the same period between a plurality of channels (a same-period known signal), configured by a plurality of the same known signals by channels; and
- 10 a transmission signal generating unit that generates transmission signals by channels, by allocating user data, and the same-period known signal, according to a prescribed frame format, and
- the communication device at a receiving side comprises:
- an initial synchronizing unit that establishes a timing
- 15 synchronization and a frequency synchronization using the same-period known signal; and
- a by-channel known signal extracting unit that extracts the known signals by channels from a reception signal, after establishing the timing synchronization.
- 20
6. The multicarrier radio communication system according to claim 5, wherein
- the communication device at the receiving side further comprises:
- 25 a despreading unit that despreads a reception signal with the

orthogonal code based on information concerning the timing synchronization;

a matched filtering unit that calculates channel impulse responses by channels from the despreaded signal; and

- 5 a preceding wave searching unit that determines a preceding wave position based on the channel impulse response, and
the by-channel known signal extracting unit extracts known signals by channels based on the preceding wave position.

- 10 7. A transmitting device (a communication device at a transmitting side) having a plurality of transmitting antennas, the transmitting device comprising:

a by-channel known signal generating unit that generates known signals by channels which are spread by a code orthogonal between

- 15 channels;

a common known signal generating unit that generates a known signal common to a plurality of channels (a common known signal); and

a transmission signal generating unit that generates transmission signals by channels, by allocating user data, the common known signal, and the known signals by channels according to a prescribed frame format.

8. A transmitting device (a communication device at a transmitting side) having a plurality of transmitting antennas, the transmitting device

- 25 comprising:

a by-channel known signal generating unit that generates known signals by channels which are spread by a code orthogonal between channels;

5 a same-period known signal generating unit that generates a repetition signal of the same period between a plurality of channels (a same-period known signal); and

10 a transmission signal generating unit that generates transmission signals by channels, by allocating user data, the same-period known signal, and the known signals by channels according to a prescribed frame format.

9. A transmitting device (a communication device at a transmitting side) having a plurality of transmitting antennas, the transmitting device comprising:

15 a by-channel known signal generating unit that generates known signals by channels which are spread by a code orthogonal between channels;

20 a same-period known signal generating unit that copies the known signals by channels, and generates a repetition signal of the same period between a plurality of channels (a same-period known signal), configured by a plurality of the same known signals by channels; and

25 a transmission signal generating unit that generates transmission signals by channels, by allocating user data, and the same-period known signal, according to a prescribed frame format.

10. A receiver (a communication device at a receiving side) having a plurality of receiving antennas, the receiving device comprising:

an initial synchronizing unit that establishes a timing

5 synchronization and a frequency synchronization using a known signal common to a plurality of channels (a common known signal); and

a by-channel known signal extracting unit that extracts known signals by channels spread by a code orthogonal between channels, from a reception signal, after establishing the timing synchronization.

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11. The receiver according to claim 10, wherein

the communication device at the receiving side further

comprises:

a despreading unit that despreads a reception signal with the

15 orthogonal code based on information concerning the timing

synchronization;

a matched filtering unit that calculates channel impulse

responses by channels from the despreaded signal; and

a preceding wave searching unit that determines a preceding

20 wave position based on the channel impulse response, and

the by-channel known signal extracting unit extracts known

signals by channels based on the preceding wave position.

12. A receiver (a communication device at a receiving side) having a

25 plurality of receiving antennas, the receiving device comprising:

an initial synchronizing unit that establishes a timing synchronization and a frequency synchronization using a repetition signal of the same period between a plurality of channels (a same-period known signal); and

5 a by-channel known signal extracting unit that extracts known signals by channels spread by a code orthogonal between channels, from a reception signal, after establishing the timing synchronization.

13. The receiver according to claim 12, wherein

10 the communication device at the receiving side further comprises:

 a despreading unit that despreads a reception signal with the orthogonal code based on information concerning the timing synchronization;

15 a matched filtering unit that calculates channel impulse responses by channels from the despreaded signal; and

 a preceding wave searching unit that determines a preceding wave position based on the channel impulse response, and

20 the by-channel known signal extracting unit extracts known signals by channels based on the preceding wave position.

14. A receiver (a communication device at a receiving side) having a plurality of receiving antennas, the receiving device comprising:

 an initial synchronizing unit that establishes a timing synchronization and a frequency synchronization using a repetition

signal of the same period between a plurality of channels (a same-period known signal), configured by a plurality of the same known signals by channels; and

- 5 a by-channel known signal extracting unit that extracts known
signals by channels spread by a code orthogonal between channels,
from a reception signal, after establishing the timing synchronization.

15. The receiver according to claim 14, wherein
the communication device at the receiving side further
10 comprises:
a despreading unit that despreads a reception signal with the
orthogonal code based on information concerning the timing
synchronization;
a matched filtering unit that calculates channel impulse
15 responses by channels from the despreaded signal; and
a preceding wave searching unit that determines a preceding
wave position based on the channel impulse response, and
the by-channel known signal extracting unit extracts known
signals by channels based on the preceding wave position.